Fauna survey in the floodplain of the Great Anabranch of the lower Darling River

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ABSTRACT

A pilot survey for vertebrate fauna was conducted in four habitats on the floodplain of the Great Anabranch of the Darling River in western New South Wales. The objective was to develop suitable techniques for surveys of the fauna diversity inhabiting these diverse and variable habitats. Live-trapping techniques were used for amphibians, reptiles, and small mammals, and birds were identified along line transects. Habitat attributes measured were the height and density of ground cover, and the depth and density of soil cracks. Total species identified included 1 amphibian, 12 reptiles, three small mammals, and 29 birds. The results indicate that satisfactory surveys in this region require an intensive input of resources and time. Seasonal timing of surveys is important for amphibians, reptiles and birds. The survey produced a new location record for *Planigale gilesi* and possible sightings of the Black-eared Miner *Manorina flavigula melanotis*.

INTRODUCTION

One of the more distinctive ecological features in western New South Wales is the extensive region of lakes and floodplain that occurs along the lower Darling River and its Anabranch. Vegetation communities associated with this area are Black Box woodlands; and chenopod, canegrass and lignum shrublands. The floodplains and lakebeds experience intermittent and irregular periods of inundation from floodwaters and alternate periods of extended dryness. Wet periods can last for months or years and dry periods can be for a few years or more than a decade (Bowler 1990). Such changes between wet and dry provide the range of habitats that would allow a diverse vertebrate fauna to inhabit the area: a fauna which is potentially very variable in composition, according to seasonal conditions. It is this potential that forms the primary focus of this study.

This paper provides results from a pilot survey of small mammals, reptiles, amphibians, and birds in the floodplain region of the Great Anabranch of the Darling River. This study describes the range of fauna inhabiting one part of these floodplain communities and also identifies key ecological questions and techniques that will help focus future survey efforts. It provides a foundation for continuing studies on the biodiversity and management of these floodplain communities, for example, Briggs (1994) and Jenkins and Briggs (1995), and so provides part of the information base on which appropriate policies can be established for the management of this region.

STUDY AREA AND METHODS

The study area was in the lower Anabranch floodplain, 33°18'S, 141°43'E (Fig. 1), and survey sites were located in an uncultivated lake and a nearby floodout area. Vegetation communities sampled at the three survey sites included the chenopod shrubland on the lake, the adjacent Black Box *Eucalyptus largiflorens* woodland, and the Canegrass *Eragrostis australasica*/chenopod shrubland on the nearby floodout area (about 4 km further east) (Fig. 2). The lake was about 1.5 km across and the surrounding band of woodland about 200 m wide.

Small mammals, reptiles, amphibians and birds were sampled along transects in the lake centre, lake edge, in the Black Box woodland beside the lake, and in the Canegrass/chenopod shrubland. Pitfall traps were used to capture small mammals, reptiles and amphibians and these were supplemented by "Elliott" brand live traps for small mammals. All survey sites consisted of three drift lines of pitfall traps aligned end to end with 150 m gaps between the ends (Fig. 3). Each drift line had 17 pitfall traps, set 6 m apart, and a 30 cm high fence of plastic sheeting running the length of the drift line and across the centre of the pitfall traps. At the end of each drift line eight Elliott traps were placed in a 10 m grid; four on each side of the drift line. In the Canegrass site an extra two traps were set at each end, using the few surplus traps (Fig. 3). Pitfall traps were 25 cm in diameter and 40 cm deep and an aluminium sheet sealed the bottom. This arrangement of drift lines and Elliott traps was similar to that used by Read (1984).

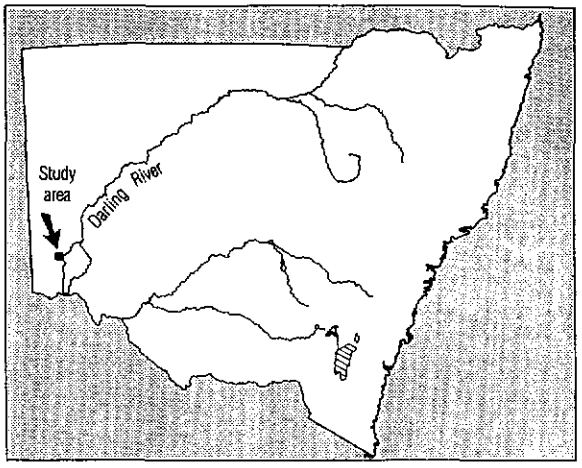

Fig. 1. Map of New South Wales which shows the study area location on the floodplain of the Great Anabranch of the lower Darling River.

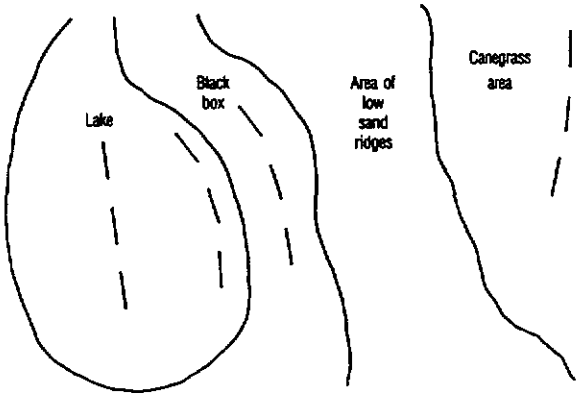

Fig. 2. Schematic diagram of study area showing relative locations of drift lines, _____.

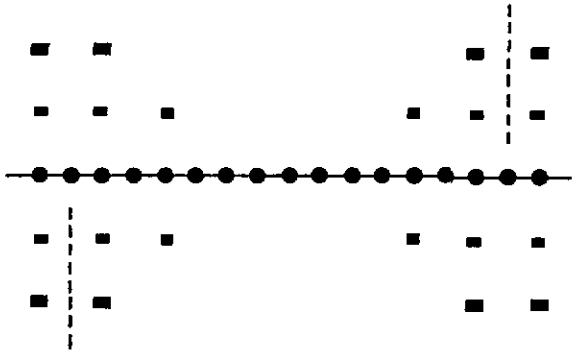

Fig. 3. Layout of traps and transects for habitat measurements at each drift line. Key: ●, pitfall trap; _____, drift fence; ▬, Type E Elliott trap; ▬, Type A Elliott trap; ■, additional Elliott in canegrass; — — —, habitat transect. Not to scale.

A mixture of rolled oats and peanut butter was used as bait in the Elliott traps. At each drift line, half the Elliott traps were Type A (33 cm × 10 cm × 9 cm) and half were Type E (23 cm × 9 cm × 8 cm). The small traps were set near the drift line and the larger ones 10 m away. The additional traps in the Canegrass were Type A and were set close to the drift line (Fig. 3). All traps were checked each morning. Trapped mammals were weighed and ear marked to distinguish individuals before being released at the capture point. All sites were surveyed for ten consecutive days from March 27, 1994.

Spotlighting for arboreal mammals in the Black Box habitat was done on one night around the edge of a much larger lake that was near the survey lake. Reptiles and amphibians caught in the pitfall traps were identified to species and released at the capture point.

Habitat assessment followed the methods detailed in Read (1987). Habitat attributes of bare ground, vegetation height, density of soil cracks, and depth of cracks were measured at 50 cm intervals along a 30 m tape. Two assessments of the habitat were taken at each drift line; one at each end (Fig. 3). The percent bare ground was the number of points registering bare ground times 100/120. Vegetation height was the mean height recorded from both ends of the drift line. Soil cracks were recorded up to 1 m from each side of the tape and the density for each drift line was the number of cracks per 120 m^2. Depth of cracks was the mean depth of the number recorded for each drift line.

Bird species at each site were identified each day in conjunction with checking the traps along a line transect that traversed the distance along the three drift lines and up to 200 m from it. A record was kept of the time spent each day searching for birds at each site. Only species were recorded, not number of individuals. Each day the sites were surveyed in an alternating order to avoid confounding of results with time of day. Large mammals, kangaroos, seen in the study sites were daily recorded and the same for incidental sightings of birds and reptiles.

RESULTS

Western Grey Kangaroos *Macropus fuliginosus* and Red Kangaroos *M. rufus* were seen on all study sites. The frequency of Red Kangaroo sightings was about 60% of that for Grey Kangaroos. No Eastern Grey Kangaroos *M. giganteus* were seen. Echidna *Tachyglossus aculeatus* dung was found in the lake edge and Black Box site, and local people know of them throughout the area.

Foxes *Vulpes vulpes*, Hares *Lepus capensis* and Rabbits *Oryctolagus cuniculus* were seen in the Black Box site and Hares also in the Canegrass site. Cattle, and on occasions sheep,

graze all sites. Two species of native small mammal were captured. These were the Paucident Planigale *Planigale gilesi* (four individuals) and the Fat-tailed Dunnart *Sminthopsis crassicaudata* (three individuals). All planigales were juveniles: three males (6.0 g–8.2 g) and one female (3.0 g). One individual was caught at each drift line in the lake centre and the fourth was caught in the lake edge. The dunnarts caught were an adult female and two juveniles, male 11.0 g and female 7.0 g, and all were in the Canegrass site. There were too few captures of native species to compare sites and only with the House Mouse *Mus domesticus* were numbers sufficient for comparisons.

The introduced House Mouse was abundant in both lake sites, common in the Canegrass, but only a few were caught in the Black Box site. The numbers of captures by the different types of trap in the survey sites are shown in Table 1. In the Canegrass site the ratio of Type A to Type E trap was 3:2 but at the other sites it was 1:1. Overall, Type A was more successful than Type E. In the lake centre site there were relatively few captures in pitfall traps but the proportion at other sites was much higher. The number of individuals captured at the survey sites, and mean mass of males and females are shown in Table 2. At all sites the difference in mass between males and females was not significant. Individuals caught at the lake edge were significantly lighter, on average, than those caught in the lake centre: $t = 4.6$, $P < 0.001$; and $t = 4.2$, $P < 0.001$, for males and females respectively.

In the lake centre, few mice were caught during the first four days of trapping but there was a sudden increase on the fifth day with high daily captures subsequently (Table 3).

Table 1. Numbers of captures of House Mice caught in the different trap types in the survey sites.

Survey site	Trap type Type A	Type E	Pitfall
Lake centre	91	50	6
Lake edge	39	10	30
Black Box	1	0	7
Canegrass	13	6	11

Table 2. Numbers of individuals and mean body mass of House Mice caught in the survey site.

Survey site	Males N	± S.D.	Females N	± S.D.
Lake centre	45	14.7 ± 3.3	40	14.2 ± 3.3
Lake edge	37	11.1 ± 3.6	20	10.1 ± 4.0
Black Box	5	10.2 ± 2.9	3	11.0 ± 3.5
Canegrass	9	12.1 ± 2.2	8	9.5 ± 2.6

Table 3. Daily captures of House Mice in the lake centre site.

Day of trapping	Individuals caught New	Total	New/Total
1	2	2	1.00
2	8	8	1.00
3	7	8	0.87
4	6	8	0.75
5	22	27	0.81
6	13	22	0.59
7	11	18	0.61
8	8	22	0.36
9	4	12	0.33
10	4	18	0.22

A similar pattern was observed at the lake edge site, indicating an influx of mice into the lake. The high proportion of new individuals caught each day until the eighth day supports this interpretation (Table 3). Alternatively, there was a very high density of mice in the lake.

Reptile species found in the sites are shown in Table 4. The greatest diversity of species was recorded in the Black Box site and the least, 1 species, in the lake centre. The only amphibian found during the survey was the Spotted Grass Frog *Limnodynastes tasmaniensis* which was found in all sites and particularly abundant in the lake centre. Numbers of individuals were not recorded. Most reptile species were seen only once but three species *Diplodactylus tessellatus*, *Pogona vitticeps* and *Morethia boulengeri* were caught or seen on three occasions all in the Black Box site.

Table 5 shows the summary of the habitat variables. The per cent bare ground was highest in the lake sites and the Black Box site had the greatest variation. Vegetation height was greatest in the lake centre and least in the Black Box site. The density and depth of cracks were greatest in the lake centre. Only a few shallow cracks were found in the Black Box and Canegrass sites. These differences in the measured habitat variables reflect the differences in the soil types and vegetation between the survey sites. The lake bed has heavy grey cracking clay; the Black Box site has a sandy substrate; and the Canegrass site has a loam soil type. Differences in the vegetation types are also indicated: tall chenopod shrubs in the lake centre; shorter, more scattered shrubs in the lake edge; scattered short grasses and herbs in the Black Box site; and in the Canegrass site, a denser ground cover of short forbs and grasses between the scattered clumps of tall Canegrass.

The daily times, mean and (range), for the bird surveys in the lake centre, lake edge, Black Box, and Canegrass sites respectively

Table 4. Reptile species caught and numbers of sightings in the different survey sites.

Lake centre		Lake edge		Black Box		Canegrass	
Menetia greyii	1	*Pogona vitticeps*	2	*Diplodactylus tessellatus*	1	*Diplodactylus tessellatus*	1
		Morethia boulengeri	2	*Rhynchoedura ornata*	1	*Pogona vitticeps*	1
		*Pseudechis australis**	1	*Pogona vitticeps*	3	*Ctenophorus pictus*	1
		Pseudonaja nuchalis	1	*Morethia boulengeri*	3	*Morethia boulengeri*	1
				Morethia adelaidensis	1	*Menetia greyii*	2
				Menetia greyii	2	*Trachydosaurus rugosus*	1
				Cryptoblepharus carnabyi	1		
				Trachydosaurus rugosus	1		
				Demansia psammophis	1		

*Seen only, all other species caught.

Table 5. Measurements of the habitat parameters in the different survey sites.

Survey site	Drift line	Bare ground	Vegetation height	Crack density	Crack depth
Lake centre	1	44	52	53	23
	2	49	47	69	32
	3	53	46	72	27
Lake edge	1	58	16	36	14
	2	46	22	59	18
	3	46	18	41	26
Black Box	1	23	6	0	0
	2	42	11	14	14
	3	33	9	2	17
Canegrass	1	33	23	0	0
	2	29	33	0	0
	3	33	13	2	9

were: 62 min. (30–110); 44 min. (25–100); 46 min. (25–75); and 44 min. (30–65). Most species of birds, 19, were found in the Black Box site (Table 6) where the daily rate or recording species, in minutes per species, varied from 2.5 on day 9 to 8.3 on day 10. The Magpie *Gymnorhina tibicen* was the only species to be recorded in all sites and four species were found at two different sites (Table 6).

Additional to the species listed in Table 6 there were incidental sightings, outside survey times, of Emus *Dromaius novaehollandiae* in the lake centre, and Little Eagle *Hieraaetus morphnoides* and Black-faced Cuckooshrike *Coracina novaehollandiae* in the Black Box. In the Black Box site, seven species were recorded on eight or more days and there were also seven species recorded only on one or two days. Of the bird species recorded once or twice, four were recorded during the first five days of surveying and three species were seen during the final five days. In the Canegrass site, the Rufous Songlark *Cinlorhamphus mathewsi* was seen on five days, the Pipit *Anthus novaeseelandiae* on four days, and Stubble Quail *Coturnix pectoralis* on three days. White-winged Wrens *Malurus leucopterus* were recorded on three days in the lake centre site. All raptor species were seen only once. On two occasions a pair of either Black-eared Miner *Manorina flavigula melanotis* or hybrids were seen in the Black Box site (see McLaughlin 1992). Positive identification of this species remained unconfirmed.

The daily pattern of bird species recorded in the Black Box site is shown in Figure 4. On average 9.4 species were identified each day. There was no relation between the number of species identified and the time spent searching, for example on day 3, 12 species were recorded in 55 minutes of search time and then on day 4, 13 species were identified in just 35 minutes of search time. Although 75% of the species in the Black Box site were recorded during the first three days of the survey, three species, 16% of the total, were recorded during the final five days (Fig. 5). This result indicates that a survey of 10 days duration was required to record most species, particularly so considering the small number of birds recorded in total. At two sites, a

Photo 1 (top left). Lake centre with *Sclerolaena* sp. shrubs and Black Box habitat in background.

Photo 2 (top right). Drift fence in lake edge.

Photo 3 (centre left). Black Box habitat with drift fence and pitfall traps.

Photo 4 (centre right). Canegrass habitat with drift fence of black plastic.

Photo 5 (bottom left). Drift fence with pitfall trap and aluminium pie-plate at the bottom.

Table 6. Bird species present in the survey sites during daily surveys.

Common name	Scientific name	Survey site			
		Lake centre	Lake edge	Black Box	Canegrass
Black Kite	*Milvus migrans*	X			
Brown Falcon	*Falco berigora*				X
Kestrel	*Falco cenchroides*				X
Stubble Quail	*Coturnix pectoralis*				X
Crested Pigeon	*Ocyphaps lophotes*			X	
Galah	*Cacatua roseicapilla*	X		X	
Mallee Ringneck Parrot	*Platycercus zonarius*			X	
Red-rumped Parrot	*Psephotus haematonotus*			X	
Blue Bonnet Parrot	*Psephotus haematogaster*			X	
Owlet Nightjar	*Aegotheles cristatus*			X	
Rufous Songlark	*Cinlorhamphus mathewsi*				X
Pitpit	*Anthus novaeseelandiae*				X
White-winged Wren	*Malurus leucopterus*	X			
Striated Thornbill	*Acanthiza lineata*			X	
Buff-rumped Thornbill	*Acanthiza reguloides*			X	
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*			X	
Brown Treecreeper	*Climacteris picumnus*			X	
Yellow-throated Miner	*Manorina flavigula*			X	X
Striated Pardalote	*Pardalotus striatus*			X	
Magpie-lark	*Grallina cyanoleuca*			X	
White-winged Chough	*Corcorax melanorhamphos*			X	
Apostlebird	*Struthidea cinerea*			X	
Pied Butcherbird	*Cracticus nigrogularis*			X	
Magpie	*Gymnorhina tibicen*	X	X	X	X
Little Raven	*Corvus mellori*			X	X
Australian Raven	*Corvus cornoides*			X	X

X — indicates species identified during daily surveys.

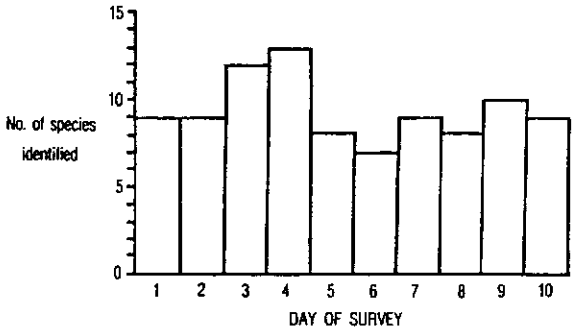

Fig. 4. Number of bird species identified on each day of the survey in the Black Box site.

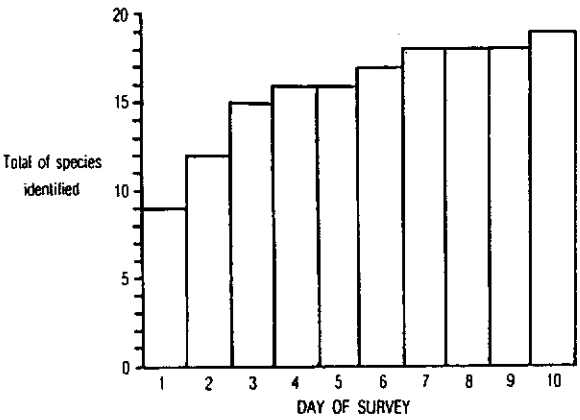

Fig. 5. The cumulative total of bird species identified daily during the survey in the Black Box site.

species was first recorded on the final day, the Black Kite *Milvus migrans* in the lake centre and the Striated Thornbill *Acanthiza lineata* in the Black Box site.

DISCUSSION

The open vegetation in the study area provided good visibility for identifying the large native mammals. The kangaroos were not overly disturbed by vehicles or survey personnel, indicating a lack of shooting pressure. No arboreal mammals were seen during the spotlighting. An inspection of this habitat in daylight found that Black Box is a species which does not develop large hollows in its larger branches or trunks. Without tree hollows to provide shelter, this habitat is basically unsuitable for the larger arboreal possums and gliders.

Read (1985) found that pitfall traps were more efficient for catching dasyurids and that Elliott traps were better for catching House Mice. Results from this study are in agreement with this, with an additional qualification concerning the amount of vegetative ground cover. In the lake centre, with the tallest vegetation, few individuals were caught in pitfall traps. Much higher proportions were caught in pitfall traps at the other survey sites, all of which had short vegetation (Tables 1

and 5). This result indicates that in habitats with short or sparse ground cover pitfall traps provide a substantial improvement in capture rates of House Mice. The finding that Type A Elliott traps were more effective than Type E must be considered relevant only to the trap layout used in this study. The two types were not randomly placed and the influence of the drift fence could bias results. Although pitfall traps were labour intensive to install, this study, among others (See Ellis and Henle 1988; Tidemann 1988), has demonstrated that they are essential to any survey for small mammals in western New South Wales.

The Mulga Snake *Pseudechis australis* was the only reptile identified without being trapped. Other reptile species were all caught in pitfall traps. One species of small lizard was caught at each survey site in the lake. Small lizards were more abundant at the Black Box and Canegrass sites. This difference in abundance may be a true representation of difference in species diversity between sites, or perhaps the numerous cracks in the lake sites reduced the efficiency of the trapping technique. The suggestion is that for reptile surveys in lake habitats, more sampling sites or repeated surveys may be required to provide a sufficient sample of species diversity.

Only one frog species was found in this study but many species in the region are burrowing frogs that emerge only after sufficient rain (see Cogger 1992). Surveys to sample the diversity of amphibians in this region should be conducted at times following rainfall events. Pitfall traps with drift fences are an efficient technique to catch frogs in the types of habitats sampled in this study (Cogger 1992).

The line transect method that was used to survey birds during the current study has been widely used in bird surveys (Recher 1989) and it was considered best for the habitats and objectives of this study. Given the low total number of species recorded, and the fact that new species were recorded late in the survey, the ten day period was a desirable length for the survey. Replication of survey sites within the Black Box habitat may improve the sampling of species that forage over large areas e.g., White-winged Chough and raptors.

From 1968 to 1981, 120 bird species were recorded from habitats on the Anabranch floodplain and the list submitted to the RAOU Atlas (M. Withers, pers. comm.). These habitats included those in the current survey plus the River Red Gum *E. camaldulensis* habitat beside the Anabranch. Five species listed in Table 6, Brown Falcon, Stubble Quail, Rufous Songlark, Buff-rumped Thornbill, and Pied Butcherbird, were not among the 120 species, although all were recorded elsewhere on the property. Except for two species, all other species in Table 6 were recorded between 1968 and 1981. The Striated Thornbill and Little Raven (Table 6) were not recorded from the property in the period 1968–81. This suggests that the survey techniques used in the current study may produce slightly better results than spot sampling which was the basic technique used to compile the 1968–81 species list.

Finding the Paucident Planigale in the lake habitat was the most significant success of the mammal trapping. This habitat is similar to habitats where it is most commonly found (Read 1987). This find also provides evidence of its continuous distribution throughout this floodplain habitat between its known localities at Menindee, about 100 km to the north, and the Murray River in Victoria, an equal distance to the south (Ellis and Henle 1988; Lumsden *et al.* 1988). The Canegrass habitat where the Fat-tailed Dunnart was found is typical for that species (Read 1987). Other dasyurids that could occur in the study area are the Narrow-nosed Planigale *Planigale tenuirostris*, Common Dunnart *Sminthopsis murina* and Southern Ningaui *Ningaui yvonneae* (see Ellis and Henle 1988; Tidemann 1988).

Recent surveys have trapped several dasyurid species elsewhere on the floodplains of the Murray and Darling Rivers. In South Australia the Paucident Planigale, Fat-tailed Dunnart, and Common Dunnart were trapped on the Murray River floodplain close to the state border of New South Wales and Victoria (Brandle and Bird 1990). In northern New South Wales the Paucident and Narrow-nosed Planigales plus the Fat-tailed Dunnart were trapped on the floodplain of the Narran River; part of a tributary network to the upper Darling River System (Smith 1993).

No native rodents were caught during this study. Forrest's Mouse *Leggadina forresti* could occur in the study area although it is about 200 km south of its known distribution (Read 1984). Individuals of this species were exclusively caught in pitfall traps, even though Elliott traps were set in a similar pattern to the current study (Read 1984). Very few native rodents in the genus *Pseudomys* have been reported from this region in western New South Wales during this century (Dickman 1994). However, in

1988 *Pseudomys bolami* was captured in South Australia on alluvial terraces adjacent to the Murray River floodplain, approximately 120 km south-west from the current study area (Brandle and Bird 1990). Also in 1988, *P. bolami* (AM 19635) was found in mallee habitat on Nanya Station about 40 km west from the current survey. This area consists of sandplain and dunefields land systems (Walker 1991) compared with the land systems of the current survey on alluvial plains, playas and basins.

There is a lack of information from surveys for reptiles and amphibians within the study region. Results from the current study represent a modest but worthwhile contribution to knowledge on these faunal groups in the region. For best results, surveys for these groups need to be done at suitable times of the year when species are most active. Future studies on the biodiversity of the region may have to conduct separate surveys for mammals and for reptiles and frogs at times when these groups are most active.

Three main habitat types are found on the floodplain; lake, Black Box, and Canegrass. There were 26 bird species identified during this study but only five species, or 20%, were found in more than one habitat. Although most species were in the Black Box, seven species occurred in either the lake or Canegrass habitats only, indicating the significance of these habitats to the overall biodiversity of the region. Future surveys must include these habitat types in order to obtain an adequate sample of bird species diversity in the floodplain. Of special interest is the probable sighting of the Black-eared Miner in the Black Box habitat and further surveys in this habitat for this species are warranted. Local people, including M. Withers, have seen it in the same habitat beside a nearby lake.

ACKNOWLEDGEMENTS

The most significant support for this study has come from the local landowners who gave permission to work on their properties. I particularly thank Alf and Maxine Withers for their keen interest in the project, kind hospitality and permission to work on their property. Angus Whyte dug the holes for the pitfall traps. Without such co-operation the study could not have been done. I am grateful to Dr Sue Briggs, (NSW) N.P.W.S., for her foresight and initiative to instigate and organize this study. My thanks also to my four cheerful assistants with the field work: Steve Thornton and volunteers Sylvia Brunner, Adam McKeown and Russell Pisel. Funds for the study came from the New South Wales. National Parks and Wildlife Service, Western Region, organized with the help of Jo Smith.

REFERENCES

Bowler, J., 1990. The last 500,000 years. In *The Murray* ed by N. Mackay and D. Eastburn. Murray Darling Basin Commission, Canberra.

Brandle, R. and Bird, P., 1990. Chpt. 4 Mammals. Pp. 80–99 in *Chowilla Floodplain Biological Study* ed by C. O'Mally and F. Sheldon. Nature Conservation Society of South Australia Inc., Adelaide.

Briggs, S. V., 1994. Ecological Impacts of cropping lakebeds. Report to New South Wales Environmental Trusts.

Cogger, H. G., 1992. *Reptiles and Amphibians of Australia.* Reed: Sydney.

Dickman, C. R., 1994. Native mammals of western New South Wales: past neglect, future rehabilitation? Pp. 81–91 in *Future of the Fauna of Western New South Wales* ed by D. Lunney, S. Hand, P. Reed and D. Butcher. Royal Zoological Society of New South Wales: Sydney.

Ellis, M. and Henle, K., 1988. The mammals of Kinchega National Park western New South Wales. *Aust. Zool.* **25:** 1–5.

Jenkins, K. M. and Briggs, S. V., 1995. Ecological Management of Lakebed cropping on the lakes of the Great Anabranch of the Darling River. Final Report to Australian Nature Conservation Agency States Co-operative Assistance Program.

Lumsden, L. F., Bennett, A. F. and Robertson, P., 1988. First record of the Paucident Planigale, *Planigale gilesi* (Marsupialia: Dasyuridae), for Victoria. *Vict. Nat.* **105:** 81–87.

McLaughlin, J., 1992. Eleventh hour for the Black-eared Miner. *Wingspan* **No. 6:** 8–9.

Read, D. G., 1984. Diet and habitat preference of *Leggadina forresti* (Rodentia: Muridae) in western New South Wales. *Aust. Mammal.* **7:** 215–17.

Read, D. G., 1985. Notes on capture techniques for small mammals for the arid zone. *Aust. Zool.* **21:** 545–50.

Read, D. G., 1987. Habitat use by *Sminthopsis crassicaudata, Planigale gilesi* and *P. tenuirostris* (Marsupialia: Dasyuridae) in semiarid New South Wales. *Aust. Wildl. Res.* **14:** 385–95.

Recher, H. F., 1989. Counting terrestrial birds: use and application of census procedures in Australia. *Aust. Zool. Rev.* **1:** 25–45.

Smith, J., 1993. A report on the vertebrate fauna of the Narran River floodplain. Internal report, National Parks and Wildlife Service, Hurstville, New South Wales.

Tidemann, C. R., 1988. A survey of the mammal fauna of the Willandra Lakes World Heritage region, New South Wales. *Aust. Zool.* **24:** 197–204.

Walker, P. J., 1991. Land systems of western New South Wales. Technical Report No. 25. Soil Conservation Service of New South Wales: Sydney.